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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/786,977	06/07/2001	Koji Takahashi	299002052200	7953

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EXAMINER

BROPHY, JAMIE LYNN

ART UNIT	PAPER NUMBER
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2822

DATE MAILED: 12/10/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/786,977

Applicant(s)

TAKAHASHI ET AL.

Examiner

J. L. Brophy

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 29 September 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-29, 32 and 33 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 32 and 33 is/are allowed.
- 6) ☒ Claim(s) 1-23 and 26-29 is/are rejected.
- 7) ☒ Claim(s) 24 and 25 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 07 June 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 13) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.
- a) ☐ The translation of the foreign language provisional application has been received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

DETAILED ACTION

This office action is in response to the RCE filed 9/29/03.

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 8/22/03 has been entered.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-5, 9-14, 18-23 and 29 are rejected under 35 U.S.C. 102(b) as being anticipated by Major et al (5,689,123).

Re claim 1, Major et al teach a method for forming a compound semiconductor layer, comprising the step of crystal-growing a group III-V compound semiconductor layer containing at least nitrogen and arsenic as group V elements on a single crystal substrate (Fig. 10 and col. 14, lines 54-58), wherein the step of crystal-growing the

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compound semiconductor layer includes the step of supplying an aluminum source material to the single crystal substrate concurrently with a nitrogen source material (col. 12, lines 42-46) such that the source materials inherently decompose on the surface of the substrate.

Rationale for inherency statement: Major et al teach that AsH_3 and/or PH_3 can be used to catalyze an NH_3 disassociation reaction. Alternatively, hydrazine (H_2NNH_2) can be used as the nitrogen source material (col. 12, lines 14-26). Since Major et al do not specifically teach that the hydrazine is subject to a disassociation reaction, it is assumed that the hydrazine is provided to the reaction chamber without disassociating (i.e.: the hydrazine provided to the system has not been decomposed). Additionally, Major et al teach that the nitrogen source material and the aluminum source material are flowed into the reaction chamber simultaneously (col. 12, lines 42-46). Analogous to the method taught in the present specification, the nitrogen source material will decompose on the surface of the substrate when exposed to the aluminum source material at specific substrate temperatures (see present specification, p. 25, lines 1-5).

Re claim 10, Major et al teach a method for forming a compound semiconductor layer, comprising the step of crystal-growing a group III-V compound semiconductor layer containing at least nitrogen and arsenic as group V elements on a single crystal substrate (Fig. 10 and col. 14, lines 54-58), wherein the step of crystal-growing the compound semiconductor layer includes the step of supplying a nitrogen source material to the single crystal substrate so that the nitrogen source material inherently

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interacts with aluminum at least on a crystal growth surface of the compound semiconductor layer (col. 12, lines 46-51).

Rationale for inherency statement: Major et al teach that AsH_3 and/or PH_3 can be used to catalyze an NH_3 disassociation reaction. Alternatively, hydrazine (H_2NNH_2) can be used as the nitrogen source material (col. 12, lines 14-26). Since Major et al do not specifically teach that the hydrazine is subject to a disassociation reaction, it is assumed that the hydrazine is provided to the reaction chamber without disassociating (i.e.: the hydrazine provided to the system has not been decomposed). Additionally, Major et al teach that the nitrogen source material and the aluminum source material are flowed into the reaction chamber separately, thereby forming an aluminum-comprising layer followed by a nitrogen-comprising layer (col. 12, lines 46-51). Analogous to the method taught in the present specification, the nitrogen source material will decompose on the surface of the substrate when exposed to the aluminum-comprising layer on the top surface of the substrate (see present specification, p. 38, lines 6-14).

Re claim 19, Major et al teach a method for forming a compound semiconductor layer, comprising the step of crystal-growing a group III-V compound semiconductor layer containing at least nitrogen and arsenic as group V elements on a single crystal substrate (Fig. 10 and col. 14, lines 54-58), wherein the step of crystal-growing the compound semiconductor layer includes the step of supplying a nitrogen source material to a crystal surface of the compound semiconductor layer in a state where the group III atoms containing aluminum are exposed to the crystal surface such that the

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nitrogen source material inherently decomposes on the surface of the substrate (col. 12, lines 46-51).

Rationale for inherency statement: Major et al teach that AsH_3 and/or PH_3 *can* be used to catalyze an NH_3 disassociation reaction. Alternatively, hydrazine (H_2NNH_2) can be used as the nitrogen source material (col. 12, lines 14-26). Since Major et al do not specifically teach that the hydrazine is subject to a disassociation reaction, it is assumed that the hydrazine is provided to the reaction chamber without disassociating (i.e.: the hydrazine provided to the system has not been decomposed). Additionally, Major et al teach that the nitrogen source material and the aluminum source material are flowed into the reaction chamber separately, thereby forming an aluminum-comprising layer followed by a nitrogen-comprising layer (col. 12, lines 46-51). Analogous to the method taught in the present specification, the nitrogen source material will decompose on the surface of the substrate when exposed to the aluminum-comprising layer on the top surface of the substrate (see present specification, p. 38, lines 6-14).

Re claims 2, 11 and 20, Major et al teach the method wherein an aluminum-mix crystal ratio in a group III element in the compound semiconductor layer is 0.02 or higher (col. 14, line 57).

Re claims 3, 12 and 21, Major et al teach the method wherein the step of crystal-growing the compound semiconductor layer is performed at a temperature of the single crystal substrate in the range of 500°C or higher and 750°C or lower (col. 12, lines 58-62).

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Re claims 4, 13 and 22, Major et al teach the method wherein the nitrogen source material contains NH_3 or H_2NNH_2 (col. 12, lines 14-26).

Re claims 5, 14 and 23, Major et al teach the method wherein more than 0% and less than 50% of the crystal growth surfaces of the compound semiconductor layer is covered with group V atoms (col. 12, lines 58-59 and col. 13, lines 3-5).

Re claims 9, 18 and 29, Major et al teach the method wherein the compound semiconductor layer further contains indium (col. 13, lines 3-5).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1, 6-8, 10, 15-17, 19 and 26-28 rejected under 35 U.S.C. 103(a) as being unpatentable over Sugiura et al in view of Major et al.

Re claims 1, 6-8, 10, 15-17, 19 and 26-28, Sugiura et al teach a method for forming a compound semiconductor layer, comprising the step of crystal-growing a group III-V compound semiconductor layer containing at least nitrogen and arsenic as group V elements on a single crystal substrate, and

Crystal-growing a layer formed of $\text{Al}_h\text{Ga}_i\text{In}_{1-h-i}\text{As}_j\text{P}_{1-j}$ on the single crystal substrate, wherein the step of crystal-growing the compound semiconductor layer and

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the step of growing the crystal formed of $\text{Al}_h\text{Ga}_i\text{In}_{1-h-i}\text{As}_j\text{P}_{1-j}$ are performed at the same temperature,

Wherein the step of crystal-growing the compound semiconductor layer is performed before and/or after the step of crystal-growing the layer formed of $\text{Al}_h\text{Ga}_i\text{In}_{1-h-i}\text{As}_j\text{P}_{1-j}$.

See col. 6, lines 55-67 and col. 18, lines 10-14.

However, **re claims 1, 10 and 19**, Sugiura et al do not specifically teach that the step of supplying an aluminum source material to the single crystal substrate may be performed concurrently with or separately from the step of supplying the nitrogen source material.

Re claim 1, Major et al teach a method that comprises the step of supplying an aluminum source material to the single crystal substrate concurrently with a nitrogen source material (col. 12, lines 42-46) such that the source materials inherently decompose on the surface of the substrate.

Rationale for inherency statement: Major et al teach that AsH_3 and/or PH_3 can be used to catalyze an NH_3 disassociation reaction. Alternatively, hydrazine (H_2NNH_2) can be used as the nitrogen source material (col. 12, lines 14-26). Since Major et al do not specifically teach that the hydrazine is subject to a disassociation reaction, it is assumed that the hydrazine is provided to the reaction chamber without disassociating (i.e.: the hydrazine provided to the system has not been decomposed). Additionally, Major et al teach that the nitrogen source material and the aluminum source material are flowed into the reaction chamber simultaneously (col. 12, lines 42-46). Analogous

to the method taught in the present specification, the nitrogen source material will decompose on the surface of the substrate when exposed to the aluminum source material at specific substrate temperatures (see present specification, p. 25, lines 1-5).

Re claim 10, Major et al teach a method that comprises the step of supplying a nitrogen source material to the single crystal substrate so that the nitrogen source material inherently interacts with aluminum at least on a crystal growth surface of the compound semiconductor layer (col. 12, lines 46-51).

Rationale for inherency statement: Major et al teach that AsH_3 and/or PH_3 can be used to catalyze an NH_3 disassociation reaction. Alternatively, hydrazine (H_2NNH_2) can be used as the nitrogen source material (col. 12, lines 14-26). Since Major et al do not specifically teach that the hydrazine is subject to a disassociation reaction, it is assumed that the hydrazine is provided to the reaction chamber without disassociating (i.e.: the hydrazine provided to the system has not been decomposed). Additionally, Major et al teach that the nitrogen source material and the aluminum source material are flowed into the reaction chamber separately, thereby forming an aluminum-comprising layer followed by a nitrogen-comprising layer (col. 12, lines 46-51). Analogous to the method taught in the present specification, the nitrogen source material will decompose on the surface of the substrate when exposed to the aluminum-comprising layer on the top surface of the substrate (see present specification, p. 38, lines 6-14).

Re claim 19, Major et al teach a method that comprises the step of supplying a nitrogen source material to a crystal surface of the compound semiconductor layer in a

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state where the group III atoms containing aluminum are exposed to the crystal surface such that the nitrogen source material inherently decomposes on the surface of the substrate (col. 12, lines 46-51).

Rationale for inherency statement: Major et al teach that AsH_3 and/or PH_3 *can* be used to catalyze an NH_3 disassociation reaction. Alternatively, hydrazine (H_2NNH_2) can be used as the nitrogen source material (col. 12, lines 14-26). Since Major et al do not specifically teach that the hydrazine is subject to a disassociation reaction, it is assumed that the hydrazine is provided to the reaction chamber without disassociating (i.e.: the hydrazine provided to the system has not been decomposed). Additionally, Major et al teach that the nitrogen source material and the aluminum source material are flowed into the reaction chamber separately, thereby forming an aluminum-comprising layer followed by a nitrogen-comprising layer (col. 12, lines 46-51). Analogous to the method taught in the present specification, the nitrogen source material will decompose on the surface of the substrate when exposed to the aluminum-comprising layer on the top surface of the substrate (see present specification, p. 38, lines 6-14).

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to modify the method disclosed by Sugiura et al by supplying an aluminum source material concurrently with or separately from supplying the nitrogen source material in order to form a crystal having desired concentrations of elements (see Major et al, col. 12, lines 37-40).

Allowable Subject Matter

Claims 24 and 25 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claims 32 and 33 are allowed.

The following is an examiner's statement of reasons for allowance: none of the references of record teach all of the process limitations as claimed. Specifically, re claims 24 and 25, none of the references teach a method that comprises sequentially performing the following steps: supplying the group III source material, supplying the nitrogen source material, and supplying the arsenic source material, in combination with the other claim limitations. Re claims 32 and 33, none of the references teach a device that comprises a light emitting layer formed of $\text{Al}_x\text{Ga}_y\text{In}_{1-x-y}\text{N}_z\text{As}_{1-z}$, wherein the Al-mix crystal ratio x in the light emitting layer is between 0.02 and 0.2, in combination with the other claim limitations. The specification teaches that the Al-mix crystal ratio x in the light emitting layer of between 0.02 and 0.2 is a critical range (see Fig. 2 and accompanying text of present specification) and, therefore, not would not be obvious to optimize.

Response to Arguments

Applicant's arguments filed 8/22/03 have been fully considered but they are not persuasive.

Applicant argues (bottom of p. 8 through p. 9 of arguments filed 8/22/03) that Major et al do not disclose the limitations recited in claims 1, 10 and 19 regarding the decomposition of the nitrogen source material and the interaction of the nitrogen source material with the aluminum source material. As discussed in the above 35 U.S.C. 102(b) rejection, such limitation are inherently taught by the Major et al reference.

Additionally, applicant argues that Major et al do not disclose or suggest non-decomposed NH_3 being supplied onto a substrate and a decomposition reaction of NH_3 being caused on the substrate. However, firstly, Major et al teach that the NH_3 source material *can* be subjected to a disassociation reaction (col. 12, lines 14-22), thereby implying that NH_3 can be provided to the reaction chamber without performing the disassociation reaction. Non-preferred embodiments constitute prior art (MPEP 2123). Secondly, the argument is not in commensurate scope with the claims since the claims broadly recite a "nitrogen source material" and are not specifically limited to NH_3 . Thirdly, Major et al teach that hydrazine may be used as the nitrogen source material, and, since Major et al do not specifically teach subjecting the hydrazine to the disassociation reaction, the hydrazine is a non-decomposed nitrogen source material.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to J. L. Brophy whose telephone number is (703) 308-6182. After January 7, 2004, the examiner can be reached at (571) 272-1835. The examiner can normally be reached on M-F (8:00-5:00).

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on (703) 308-4905. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9318.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

Jamie L. Brophy

jlb

Jamie L. Brophy